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## Neurology practice during the COVID-19 outbreak and post-pandemic era: experiences and challenges

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## **Introduction**

As severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19, is highly infectious and variable, and given that we now understand a large proportion of asymptomatic carriers can be still infectious [1], it is expected that a normalization of epidemic prevention and control measures will be required for a long time worldwide. Our neurology department at Xuanwu Hospital in Beijing is one of the national centers for the research and treatment of neurological disorders in China. Since healthcare settings are at a high risk of virus dissemination, we have implemented timely strategies to reduce cross-infection and protect our patients and staff to avoid critically overload our system for a sudden decrease of our staff because of quarantining or isolation [2]. Moreover, having made it through several months of this crisis, it is now clear to us that the pattern of clinical practice and research at our hospital has already undergone major changes, many of which are very likely to persist well into the future. Here, we summarize our experiences in adapting neurological practice during the COVID-19 outbreak and post-pandemic era, and we discuss how our experiences are helping us think about and meet some unsolved problems and challenges.

## **Emergency and inpatient care**

During the SARS epidemic in 2003, China established fever clinics in all general hospitals (above level two) [3]. Each outpatient with a body temperature higher than 37.3°C will go to fever clinics first to screen for the potential infectious diseases. Policies assure that fever clinic staff are equipped with enhanced medical personal protective equipment (PPE) relative to the normal medical staff of a hospital. At Xuanwu Hospital, patients with neurological emergencies accompanied by fever are first sent to the fever clinic, and the neurologists go to the fever clinic to treat these patients. Our fever clinic is equipped with a dedicated computer tomography (CT) scanner. Therefore, patients with acute ischemic stroke can be treated with intravenous thrombolysis without leaving the fever clinic.

We adopted several changes in our inpatient management strategies and optimized our workflow to admit patients from the emergency room (ER) or clinics. First, we deployed a multidisciplinary team (MDT) screening protocol, seeking to detect asymptomatic inpatients with potential SARS-CoV-2 infection. The MDT comprises ER neurologists, radiologists, ER internists, and consulting pulmonologists along with infectious disease specialists. Information spanning four categories was obtained, including detailed epidemiological information, core clinical features of COVID-19 (fever and/or respiratory symptoms), a chest CT scan, and a complete blood count. If patients have conditions that may preclude

completion of CT, lung ultrasound is an alternative option [4]. The team stratified incoming patients based on an evaluation of the above risk factors. As nucleic acid testing capability increased over time, we integrated nucleic acid tests into our protocol (since April, 2020). Thus, every patient is carefully screened for COVID-19 infection prior to admission.

Second, after admission, we set up a transitional ward that was designed to solve two major problems we were facing: a shortage of PPE and a limited number of single rooms. The rationale for the transitional ward was based on the incubation period of COVID-19 from early reports of confirmed COVID-19 cases in Hubei, China [5]. We dedicated one floor of our wards for this purpose, and the transitional ward used a relatively higher level of PPE. Newly admitted patients would spend 5 days in the transitional ward and were transferred to the regular ward with standard PPE. Notably, virtual visitations were encouraged for patients in the transitional ward, which did not permit physical entry for any visitors. Importantly, we enforced different levels of PPE depending on the assessment of anticipated exposure risk (summarized in Figure 1) and deployed mandatory training programs to ensure the appropriate use of PPE.

--- insert figure 1 at here ---

### **Outpatient care**

The largest-scale changes we have deployed in the pandemic and post-pandemic periods deal with remote care of patients for whom in-person clinic visits has become unfeasible. Obviously, telemedicine technologies have been extensively developed in the past. However, there have been some major barriers to the widespread deployment of telemedicine. Given the unique context our department faced with COVID-19, we were able to deploy some real telemedicine innovations that allowed us to provide continuous care for patients with chronic neurological disorders.

Firstly, Xuanwu Hospital has developed the “Xuanwu-APP”, which supports online consultation, the scheduling of appointments, checking of test results, prescription writing, and coordination of the physical delivery of medicines. Beyond these relatively obvious advantages, the fundamental enabling aspect of the Xuanwu-APP is its integrated implementation of medical insurance coverage: this enabled reimbursement of patients for telemedicine services, which profoundly increased the utilization rates of our patients. We found that once the patients were comfortable with the reimbursement options, they were eager to engage with our physicians via telemedicine. It is notable that the APP and the reimbursement functionality also facilitated specialist consultations with experts at senior hospitals, which substantially reduced the need for highly resource-intensive patient transfer between hospitals in the pandemic. If remotely monitored outpatient presents suspected features of COVID-19, we will suggest the patients to visit fever clinic immediately with appropriate personal protection.

## **New technologies and impacts on clinical research**

Our recently gained experience using remote technologies has us very excited about their integration into the design and management of clinical research. For example, videoconferencing is optimal for conducting pre-trial screening and for both participant training and consultation. For many interventions under study, online supervision should be acceptable. Further, participants can be encouraged to record and upload a video when taking study drugs or conducting non-pharmacological interventions, and an e-diary (with attendant notification functionality) can clearly be a useful digital tool for monitoring symptoms and side effects. Currently, multi-center neuroimaging trials have become a trend, though there are still challenges to correct for heterogeneity among centers [6]. We are highly confident that collaboration among regional or even nationwide multi-site neuroimaging facilities will increase in the wake of this crisis, primarily because of its obviously improved convenience and safety for participants.

## **Summary**

Our strategies and insights about future directions could be valuable as a reference for the global neurology community. There are still many ongoing challenges related to COVID-19, but we warrant that this crisis can be viewed as a powerful chance to advance the implementation of new technologies that facilitate pandemic-specific changes as well as attractive upgrades that can profoundly affect both clinical practice and research in the post-COVID 19 era.

## **Contributors**

YX, LLC, CJW and XMW drafted initial text. HQS, LYW, JXS and HC searched the relative materials. YT, YPW and GGZ conceived the viewpoint and revised the manuscript.

## **Declaration of interests**

We declare that we have no conflict of interests.

## **Data availability statement**

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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**Figure 1: A proposed guideline for application of personal protection equipment by healthcare workers.**

Regular O/P Clinics: regular outpatient clinics; Regular I/P Wards: regular inpatient wards; MED Tech.: medical technician; In Cont. w/ PTS or SPEC: in contact with patients or specimen; Transitional I/P Wards: Transitional inpatient wards; Triage (Regular O/P Clinics): Triage (Regular outpatient clinics); Fever Clinic, ER, PEDS Clinic/ER, RESP Clinic: Fever clinic, Emergency Room, Pediatric Clinic/Emergency Room, Respiratory Clinic; In Cont. w/ Susp. or Conf. Covid-19 Cases: In contact with suspected or confirmed Covid 19 cases; ISOL Unit: Isolation unit; TRF Team: Transfer team; SPEC Collection: Specimen collection; SPEC Transport: Specimen transport; Lab Tech: Laboratory technician; Other MED Tech: other medical technician; MED Waste Mgmt.:medical waste management; ENVR Svcs.: Environmental service; Temp. CK Supervisor in Public Space: temperature check supervisor in public space.

✓:required; ○: selected based on exposure risk.

		Hand Hygiene	Uniforms	Disposable Caps	Disposable Surgical Masks	Medical N95 Respirators	Disposable Coveralls	Disposable Gloves	Disposable Isolation Gowns	Face Shield/ Eye Goggles	Disposable Shoe Covers	Work Boots
Regular O/P Clinics	Regular I/P Wards	✓	✓	✓	✓			○	○	○		
	MED Tech.											
	In Cont. w/ PTS or SPEC											
	Transitional I/P Wards											
Triage (Regular O/P Clinics)		✓	✓	✓	✓					✓		
Fever Clinic, ER, PEDS Clinic/ER, RESP Clinic		✓	✓	✓	✓	○		○	○	○	○	
In Cont. w/ Susp. or Conf. Covid-19 Cases	ISOL Unit	✓	✓	✓		✓	✓	✓✓	○	✓	✓	✓
	TRF Team	✓	✓	✓		✓	✓	✓		○	○	○
	SPEC Collection	✓	✓	✓		✓	✓	✓✓	○	✓	○	
	SPEC Transport	✓	✓	✓	✓			✓				
	Lab Tech.	✓	✓	✓		✓		✓	✓	○		
	Other MED Tech.	✓	✓	✓		✓	✓	✓		✓	✓	
	MED Waste Mgmt.	✓	✓	✓		✓		✓✓	✓	✓		✓
	ENVR Svcs.	✓	✓	✓		✓	✓	✓✓	✓	✓	✓	
Temp. CK Supervisor in Public Space		✓	✓		✓			✓				

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